

Worksheet 1. What You Need to Know About Motion Along the x -axis (Part 1)

In discussing motion, there are three closely related concepts that you need to keep straight. These are:

position $x(t)$: location on the x -axis at time t .
 velocity $v(t) = x'(t)$ how fast position is changing + direction
 acceleration $a(t) = v'(t) = x''(t)$ how fast velocity is changing

If $x(t)$ represents the position of a particle along the x -axis at any time t , then the following statements are true.

1. "Initially" means when time = 0.
2. "At the origin" means $x(t)$ = 0.
3. "At rest" means $v(t)$ = 0.
4. If the velocity of the particle is positive, then the particle is moving to the right.
5. If the velocity of the particle is negative, then the particle is moving to the left.
6. To find average velocity over a time interval, divide the change in position by the change in time.
7. Instantaneous velocity is the velocity at a single moment (instant!) in time.
8. If the acceleration of the particle is positive, then the velocity is increasing.
9. If the acceleration of the particle is negative, then the velocity is decreasing.
10. In order for a particle to change direction, the velocity must change signs.
11. One way to determine total distance traveled over a time interval is to find the sum of the absolute values of the differences in position between all resting points.
Here's an example: If the position of a particle is given by:

$$x(t) = \frac{1}{3}t^3 - t^2 - 3t + 4,$$

find the total distance traveled on the interval $0 \leq t \leq 6$.

$$x'(t) = t^2 - 2t - 3$$

$$0 = (t-3)(t+1)$$

$$t-3=0 \quad t+1=0$$

~~$$t = -1$$~~

$$t = 3$$

$$x(0) = 4$$

$$x(6) = 22$$

$$x(3) = -5$$

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